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AN ILLUSTRATION *and* CONFIRMATION *of* SOME FACTS *mentioned in an* ESSAY *on the* PRIMITIVE STATE *of the* GLOBE.*

By RICHARD KIRWAN, *Eſq*; *L. L. D. F. R. S. and P. R. I. A.*

Read May 5th, 1800.

THERE is a remarkable fact, ſtated in this eſſay, with reſpect to which the Moſaic account is fully at iſſue with the moſt plauſible of the lately deviſed philoſophic theories of the primitive ſtate of the globe, namely, the emerſion of ſome portion of land from the primæval ocean, previous to the creation of fiſh. Moſes expreſsly affirming, Buffon, the anonymous author of *L'hiſtoire du Monde primitif*, and many others, expreſsly denying it. In proof of the Moſaic account I alleged that no petrifactions were found imbedded and incorporated in maſſes of ſtone in ſuch countries as were elevated 8500 or 9000 feet above the actual level of the ſea; for inſtance, in the great Tartarian platform and the elevated regions of Siberia, though in all inferior regions of the ſame extent ſuch petrifactions were abundantly found, at leaſt in limeſtones; but even in theſe none were found in thoſe elevated tracts, as I proved by the teſtimonies

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* See Vol. VIth of the Tranſactions of the Academy.

nies of all the philoſophic travellers who have traverſed and examined them.

Bouguer and Don Ulloa * atteſt the ſame fact with reſpect to Quito and the lofty regions of South America, having met with none in ninety leagues from a little north of the Æquator to Cuenca, between 2° and 3° ſouth of it, Quito being elevated 9374 feet above the level of the ſea. I even doubted whether the petrifactions found by Mr. De Luc on Mount Grenier at the height of 7800 feet, were incorporated in the body of any ſtony maſs, but he has ſince aſſured me that they were; now the ſhells he found, being *Cornua Ammonis*, a ſpecies of thoſe called *Pelagicæ*, it would thence appear that the ſea had riſen ſtill higher, though not above 100 feet.

To repel this proof of the Moſaic account, it has been replied by the laborious, learned and eloquent writer of the *L'hiſtoire du Monde primitif* and others, that the keen air exiſting in theſe elevated regions had long ago decompoſed and conſumed the ſhells that might have been there depoſited; but as the ſtones ſtill remain, it is evident that the ſhells incorporated in their interior muſt alſo have remained, if any ſuch were ever contained in them.

However,

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* Bouguer Figure de la Terre, p. lxv. Don Ulloa, Mem. Philoſoph. vol. I. p. 363.

However, it is inſiſted that petrified ſhells have been found at a far ſuperior height to that which I ſtated as the higheſt limit at which they could be found, namely 9000 feet, for that thoſe which I quoted as proofs of a ſubſequent deluge, found, according to Don Ulloa, at the height of 14,220 feet in Peru, were in reality petrified. To this account, as it was only a hearſay report of Gentil, who had it from Don Ulloa, I own I did not give full credit, at leaſt I thought the circumſtance of their having been petrified and imbodied in a rock not probable; ſince that time I have met with a work, compoſed by Don Ulloa himſelf, intitled *Memoires Philoſophiques, Hiſtoriques & Phyſiques*, in the firſt vol. of which, p. 34 and 364, the fact of the ſhells being petrified and imbodied in a rock is fully ſtated and confirmed; but I ſhall here ſatisfactorily prove that the height at which they were found did not exceed, nor even equal 9000 feet above the level of the ſea. And, ſecondly, that they were left there by a deluge that ſucceeded the emerſion of land from the primæval ocean.

1°. Gentil tells us, Mem. Par. 1771, p. 439 in 8vo. that theſe ſhells were found on a mountain near Guancavelica, a ſmall town or village between 12° and 13° ſouth latitude, which mountain he ſays is far from being one of the higheſt of the Cordelieres, and that on the ſpot in which the ſhells were found the mercury in the barometer ſtood at the height of 17 inches, one line and $\frac{1}{4}$=17,103 inches, from which he infers that this ſpot was elevated 2200$\frac{1}{3}$ toiſes over the level of the ſea, = 13,869 Engliſh feet. This height I ſhall now ſhew to have been falſely eſtimated.

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Don Ulloa tells us, p. 34 of the above-mentioned work, and Gentil repeats after him, that, at the village of Guancavelica, near, but ſomewhat below this ſpot, the mercury ſtood at the height of 18 inches, one line and ½. Now Bouguer, *Figure de la Terre*, p. xxxvi, expreſsly ſays that Quito is elevated from 14 to 1500 toiſes only over the level of the ſea, and is the higheſt *inhabited* part of the globe; Guancavelica, therefore, which is inhabited, and muſt have been well known to Bouguer, cannot be ſo high as Quito. Quito was geometrically meaſured, Guancavelica was not.

Bouguer alſo tells us, *ibid.* in note, that the mercury at Quito ſtands at the height of twenty inches and one line; how then is it poſſible that it ſhould ſtand at eighteen inches and one line at Guancavelica which muſt be much lower, if the barometer were not ill conſtructed? No difference of temperature between Quito and Guancavelica could cauſe ſuch an enormous difference as two inches in the mercurial height. The art and neceſſity of freeing barometers from air were not generally known * before Mr. De Luc's immortal work on the modifications of the atmoſphere, which was not

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* I ſay not generally known, becauſe though Mr. Du Fay had ſhewn the advantage of expelling air from the mercury in the tube, in Mem. Par. 1723, and Caſſini had followed that method in meaſuring the heights of Puy de Dome and Mont D'Or in 1740, yet it was not generally adopted until Mr. De Luc had proved its neceſſity and perfected the method of performing it in 1772. See 1 De Luc, p. 58.

not publiſhed 'till upwards of thirty years after Don Ulloa's experiments. The air then remaining in his barometer, which he probably filled at Lima, in whoſe territory Guancavelica lies, under a preſſure of twenty-eight or between twenty-ſeven and twenty-eight (French) inches, muſt have conſiderably expanded and depreſſed the column of mercury under it, when brought up a mountain of perhaps 7000 or 8000 feet high; and hence this mercurial column remained ſo low at Guancavelica as eighteen inches and one line.

THAT in theſe circumſtances the air contained in the barometer might cauſe a difference of three inches or more between the height at which mercury purged of air would ſtand, appears by the experiments of Caſſini, Mem. Par. 1740, *Sur la Meridienne de Paris*, p. clxxii. for he found that the mercury, freed from air by ebullition in the tube, ſtood four or five lines higher than in barometers filled without that precaution. Nay, Cardinal Luynes found the difference betwixt ſuch barometers to amount ſometimes to fourteen lines, Mem. Par. 1768, p. 490 in 8vo. How great muſt it therefore be in barometers tranſported to greater heights than that at which they were filled?

MOREOVER, Don Ulloa expreſsly tells us that the mountain on which theſe ſhells were found was *every where habitable*, *Mem. Philoſophiques*, p. 34 and 35, which it could not be, and would be expreſsly contradicted by Bouguer, if its height were 13,000 Engliſh feet over the ſurface of the ſea. From all which I conclude that the height of the mercurial column, if the barometers had been properly conſtructed, would have been about 22 French inches =23, 44 Engliſh, and as the temperature was remarkably cold this would indicate a height of about 8200 feet above the level of the ſea.

But, ſecondly, let the height be what it may, it is certain that theſe ſhells were depoſited there after the emerſion of land from the primitive ocean, and conſequently by a ſubſequent deluge; for Don Ulloa expreſsly tells us, that in the ſame rocks in which theſe ſhells are found, *petrified wood* is alſo found, Mem. Philoſophiques, p. 372. This wood muſt have grown on dry land, and muſt have been floated when the ſhells were depoſited, ſince both are found in the ſame rocks. It muſt have been brought thither by a deluge, as no wood can at preſent grow there, as Don Ulloa alſo atteſts. The ſhells are for the moſt part bivalves, which geologiſts allow to form petrifactions of the moſt modern date.

Lastly, La Peyrouſe mentions that he diſcovered marine ſhells on Mount Perdu, the higheſt of the Pyrenees, at the height of nearly 10,000 feet. How he aſcertained the height is not mentioned; but that theſe ſhells were depoſited by the deluge is certain, for at the ſame height he found alſo the bones of land animals petrified, 37 Journ. des Mines, p. 59, 60 and 64.